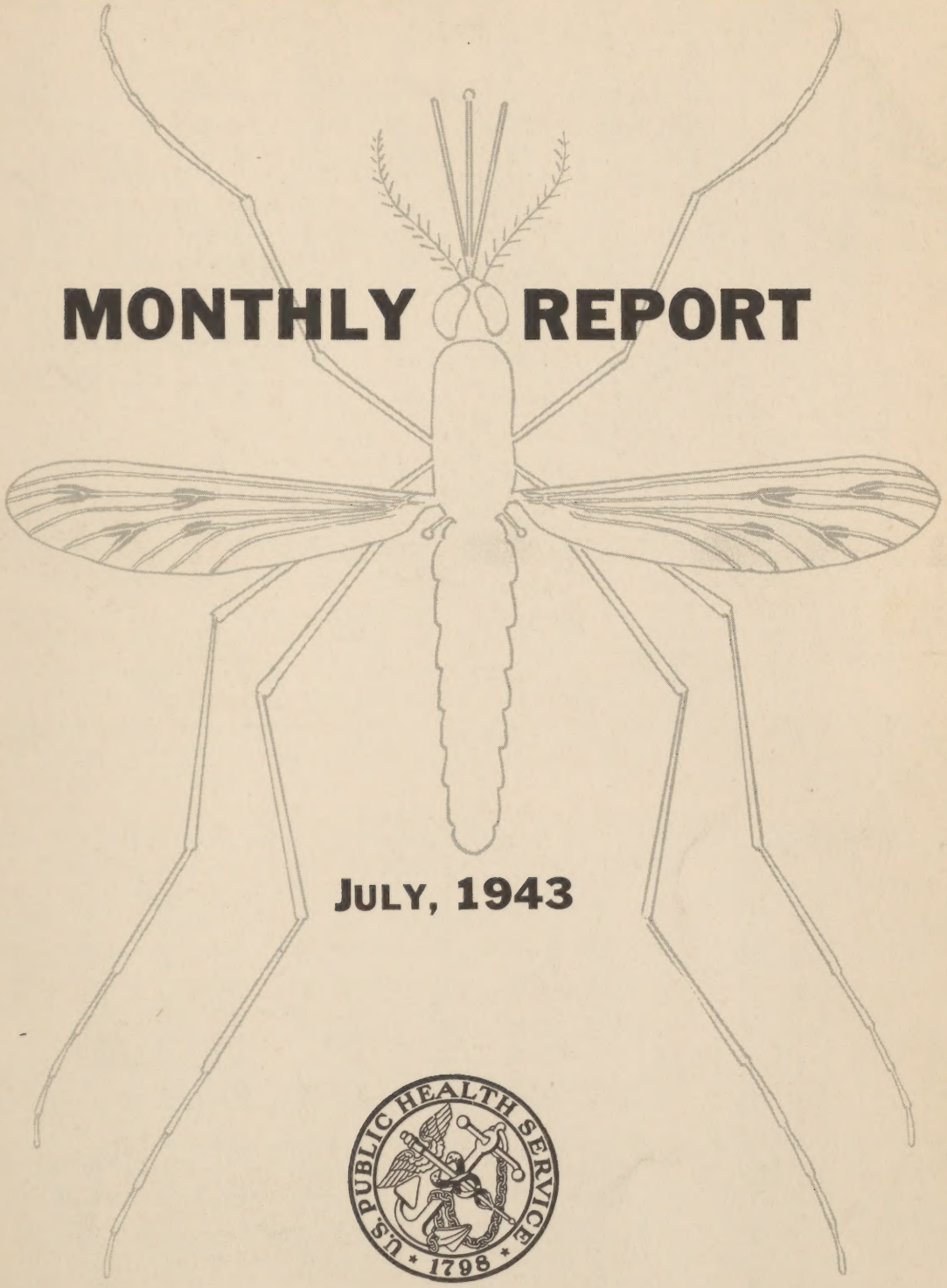
Geo. D. Tremmel

MALARIA CONTROL IN WAR AREAS



MONTHLY REPORT

JULY, 1943

FEDERAL SECURITY AGENCY

U. S. PUBLIC HEALTH SERVICE

ATLANTA, GEORGIA

TABLE I — MCWA LARVICIDE AND MINOR DRAINAGE PROJECTS — JULY 1 - 31, 1943

STATE	Areas in Operation	War Establishments Protected	LARVICIDAL WORK: Larvicide Used: Oil Gals.	Paris Green Lbs.	Surfaces Treated Acres	OTHER WORK: Ditching Cu.Yds.	Lin.Ft.	Cleaning Lin.Ft.	Clearing Acres	Water Surf. Eliminated Acres	Total Man Hours	Total Men Employed
Alabama	8	64	1,207	28	66.3	436	1,868	28,825	1.9	17.6	5,654	52
Arkansas	15	63	19,166	1,242	2,135.0	885	7,707	706,955	44.2	5.8	29,255	153
California	3	11	6,799	---	632.5	---*	10,788	700	29.2	31.7	3,910	20
D. C.	1	23	332	---	6.3	231	12,906	36,318	3.5	0.2	4,058	21
Florida	16	91	5,964	369	533.8	5,821	93,902	1,662,370	20.8	107.4	41,725	230
Georgia	13	93	279	2,907	3,775.6	799	3,395	125,295	33.9	12.2	30,152	146
Illinois	2	54	2,875	566	594.5	78	800	6,005	---	3.0	5,596	28
Indiana	1	40	560	21	32.2	175	1,168	---	0.3	---	2,060	10
Kentucky	5	48	1,187	---	56.5	118	1,191	26,315	14.8	0.8	9,912	53
Louisiana	8	71	106,036	2,177	7,438.2	880	11,487	86,531	35.3	9.4	73,863	385
Maryland	2	21	356	4	16.5	243	1,100	41,480	2.9	0.1	5,016	19
Mississippi	10	50	11,462	79	423.3	1,028	4,236	144,108	77.0	6.6	23,430	115
Missouri	4	24	2,770	763	1,451.9	533	1,820	72,880	1.5	10.0	10,211	48
North Carolina	11	69	12,857	18	614.9	4,546	13,536	946,908	97.4	23.2	44,655	223
Oklahoma	5	21	6,682	251	538.0	173	3,736	93,802	14.8	2.1	9,929	44
Puerto Rico	5	22	993	8,035	5,048.0	---*	216,612	162,440	23.8	1.1	61,362	371
South Carolina	20	101	22,824	1,276	2,159.5	1,779	31,600	390,787	287.2	6.7	51,682	247
Tennessee	7	69	27,838	433	1,137.4	494	1,455	42,734	6.3	0.1	14,657	69
Texas	14	140	23,191	195	1,239.6	1,671	36,294	249,585	90.1	16.3	42,976	231
Virginia	4	83	25,930	---	588.9	---*	22,847	27,392	59.9	---	34,745	172
Total	153	1,158	279,308	18,364	28,488.9	19,890	478,448	4,851,430	844.8	254.3	504,848	2,637
June Total	144	1,143	208,439	19,467	19,910.9	43,787	666,732	3,344,078	913.4	277.5	471,650	2,500

*No figures available.

TABLE II — MCWA MAJOR DRAINAGE PROJECTS — JULY 1 - 31, 1943

STATE	No. of Projects	Clearing Brushing Acres	Channel or Ditch Cleaning Lin.Ft.	New Ditching: Hand	Lin.Ft. Mech.	Dynamite	Total Cu.Yds.	Fill Cu.Yds.	Ditch Lining Placed Sq.Ft.	Lin.Ft.	Underground Drains Lin.Ft.	Water Surf. Eliminated Acres	Total Man Hours
Alabama	2	5.9	2,740	700	---	7,100	7,155	---	---	---	---	155	5,813
Arkansas	2	0.3	1,400	1,100	---	21,050	20,174	---	---	---	---	241	1,197
Florida*	1	---	---	---	---	3,472	---	---	---	---	---	---	126
North Carolina	4	33.0	54,691	4,765	3,010	---	13,178	143	---	---	---	27	10,887
Puerto Rico	2	5.5	---	1,150	---	---	3,316	---	400	---	---	---	49,687
South Carolina	3	---	---	291	1,400	4,800	5,484	389	1,634	998	---	15	4,961
Texas	2	1.3	2,500	4,775	---	---	1,560	52	---	---	---	2	3,103
Virginia	1	0.2	666	---	---	---	---	---	---	3,380	---	---	2,820
Total	17	46.2	61,997	12,781	4,410	36,422	50,867	584	2,034	4,378	---	440	78,731
June Total	27	119.8	130,425	28,137	9,835	18,280	41,098	2,396	9,960	3,135	160	510	94,931

*Represents two weeks only.

TABLE III — MCWA PERSONNEL ON DUTY ON JULY 31, 1943 AND TOTAL PAYROLL FOR MONTH OF JULY — JULY 1 - 31, 1943

STATE	Commissioned: No.	Pay	Prof. & Sci.: No.	Pay	Sub-Prof. (1): No.	Pay	C. A. F.: No.	Pay	Custodial: No.	Pay	Total: No.	Pay	Percent of Total: No.	Pay
Alabama	3	855	3	791	2	468	2	410	61	6,893	71	9,417	2.0	2.0
Arkansas	5	1,442	2	917	23	4,233	3	639	135	17,117	168	24,348	4.7	5.1
California*	1	200	-	---	-	413	-	229	--	1,621	1	2,463	0.1	0.5
D. C.	2	677	2	522	3	550	2	328	19	2,479	28	4,556	0.8	1.0
Florida	2	428	8	2,055	19	4,087	6	905	223	28,257	258	35,732	7.2	7.5
Georgia	2	513	5	1,241	36	6,822	6	894	105	13,146	154	22,616	4.3	4.7
Illinois	2	618	4	1,004	7	1,322	4	696	16	1,948	33	5,588	0.9	1.2
Indiana	1	285	-	---	1	183	-	---	8	1,114	10	1,582	0.3	0.3
Kentucky	3	855	4	1,110	14	2,250	3	556	31	5,199	55	9,970	1.5	2.1
Louisiana	7	2,023	8	2,305	36	5,870	5	2,060	350	45,635	406	57,893	11.3	12.2
Maryland	-	---	-	---	2	446	2	410	20	2,648	24	3,504	0.7	0.7
Mississippi	4	1,141	2	571	13	2,642	3	502	107	14,452	129	19,308	3.1	4.1
Missouri	2	570	5	1,313	13	2,555	5	872	41	4,614	66	9,924	1.3	2.1
N. Carolina	6	1,568	8	2,506	14	2,609	3	574	280	35,478	311	42,735	8.7	9.0
Oklahoma	2	578	-	---	5	973	-	---	33	4,709	40	6,260	1.1	1.3
Puerto Rico	6	1,945	-	---	9	1,584	5	801	596	26,788	616	31,118	17.2	6.5
S. Carolina	5	1,437	5	1,444	34	6,887	5	738	285	37,106	334	47,612	9.3	10.0
Tennessee	8	2,281	2	477	7	1,858	2	537	69	8,792	88	13,945	2.5	2.9
Texas	4	1,062	7	2,237	31	5,843	5	738	232	28,643	279	38,523	7.8	8.1
Virginia	2	570	2	1,151	14	2,528	2	428	155	19,502	175	24,179	4.9	5.1
AEDES AEGYPTI														
Florida	1	285	-	160	36	6,313	-	155	22	3,142	59	10,055	1.6	2.1
Georgia	-	---	1	319	8	1,569	1	246	--	---	10	2,134	0.3	0.4
Louisiana	-	---	-	---	14	2,955	1	146	2	208	17	3,309	0.5	0.7
Texas	2	570	2	329	8	1,613	2	219	1	4,066	15	6,797	0.4	1.4
H. Q. & Dist. (2)	36	11,402	12	3,185	93	15,076	83	12,287	7	858	231	42,808	6.5	9.0
Total	106	31,305	82	23,637	442	81,649	150	25,370	2,798	314,415	3,578	476,376		
Percent of Total	3.0	6.6	2.3	5.0	12.3	17.1	4.2	5.3	78.2	66.0	100.0	100.0	100.0	100.0

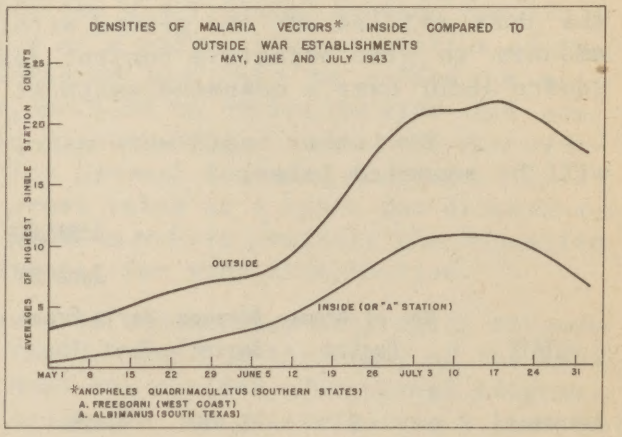
*Figures estimated same as June
(1) Includes Entomological Inspectors
(2) Includes Headquarters and District Offices, malaria survey, special investigations and employees temporarily attached to Headquarters pending assignment to States

MONTHLY REPORT
MALARIA CONTROL IN WAR AREAS
JULY, 1943

Larvicidal and minor drainage work for the protection of 1158 war establishments was conducted during July, with a total of 279,308 gallons of oil and 18,364 pounds of paris green being used to treat 28,489 acres of breeding surface. In addition, 30,399 pounds of paris green was applied by airplane to 24,921 acres which could not have been effectively or economically larvicide by any other means. About 254 acres of breeding surfaces were eliminated by nine miles of minor ditching. A total of 2,637 men were employed for these activities.

QUAD POPULATIONS RISE IN JULY LOWERED BY END OF MONTH

As would be expected during the advancing season, *Anopheles quadrimaculatus* densities over the country as a whole showed a gradual increase until mid-July. Resting station counts of adults both inside and outside war establishments reached a peak for the current season the week of July seventeenth after which the counts at both inside and outside stations declined rather sharply. This is shown on the accompanying chart. In preparing this graph, as was explained in a previous report, the highest single index station count in each area is used, which tends to minimize the actual control being effected. The general average of counts at the highest stations during the early part of July reached 10, which is above desirable limits. Seventy-eight, or approximately 17% of the control zones showed individual stations with counts higher than the average. In these cases entomological records have served to bring the conditions to light, and to indicate the breeding areas where supplementary control was necessary.



ARMY GENERAL HOSPITALS; PRISONER OF WAR CAMPS CAREFULLY WATCHED

Special attention is being given by the MCWA program to areas adjacent to the 53 Army general hospitals where casualties from malarious areas may be quartered. Control operations are under way at 22 of these hospitals; 12 are being kept under entomological surveillance, and survey work has been completed at seven. The remaining 12 are located in areas which are believed safe from the possibility of malaria transmission due to the probable absence of the mosquito vector.

At 13 of the 26 prisoner of war camps which have been established in this country, malaria control work is under way. Three are under surveillance and 10 are in what are considered to be non-malarious areas.

AIRPLANE DUSTING PROGRAM EXPANDED
WASHINGTON POST FEATURES POTOMAC RIVER WORK

The MCWA airplane dusting program moved forward at an accelerated pace during the month of July. At one time there were 8 projects in operation, covering areas in five States. The most extensive of the projects was that being carried out on the Potomac River water chestnut area.

On July 25 the *Washington Post* carried a lengthy and most favorable article on the Potomac River work. The author, Tom Moore McBride, stressed the importance of malaria control in the Potomac, and explained the methods employed in keeping down *Anopheles quadrimaculatus* production. Mr. McBride pointed out that control work was instituted last summer when an increased prevalence of *Anopheles quadrimaculatus* was noted. He stressed the fact that conditions in the slow-flowing water of the creeks and Potomac backwaters where the water chestnuts stretch in unbroken rafts, afford ideal conditions for breeding. Another contributing factor, he stated, is the absence of fish life, brought about by the choking tentacles which hang from the leafy top of the water chestnut and make the waters untenable to fish.

At the suggestion of Dr. L. L. Williams, Jr., a few preliminary tests were made during the month to determine the suitability of undiluted paris green for dusting by airplane. These tests were conducted in Louisiana with the cooperation of State officials.

The tests were run with a plane speed of 95 miles per hour at a 50 foot elevation and with a wind of approximately 8 miles per hour. It was found that the dust settled to the ground within about 400 feet downwind in sufficient amounts to give effective control (as determined from paris green counts per square inch) over a downwind swath at least 1000 feet wide.

A few other tests were made, some over actual breeding grounds, which will be reported later.

AIRPLANE DUSTING PROGRAM

June 28 - July 31

STATE	No. of Areas Dusted	Acreage Dusted	Paris Green Used Lbs.	Diluent Used Lbs.	Paris Green Per Acre	Dusting Time Hours	Total Man Hours
Arkansas	2	5,610	4,569	20,806	0.8	27:22	610
Louisiana	3	4,130	9,211	18,822	2.2	13:20	629
Mississippi	1	175	440	1,760	2.5	1:55	104
Tennessee	1	350	500	2,000	1.4	3:22	96
Potomac River	1	14,656	15,679	52,528	1.0	90:01	1,768
Total	8	24,921	30,399	95,916	1.2	136:00	3,207

MAJOR DRAINAGE DECREASED DURING JULY
DYNAMITE CONTINUED TO PLAY IMPORTANT ROLE

Due to increased larvicidal operations, very little major drainage work was undertaken in July. Proposals were submitted for three projects totaling $8993.

Project proposals for major drainage work to be accomplished during the current fiscal year will be submitted on a unit project basis rather than on an area basis. This procedure was outlined in the revised Manual of Operations which was distributed in July.

Drainage work carried on last winter was praised by Louisiana officials who pointed out that it has been instrumental in reducing mosquito counts in some of the areas, and in a few cases has eliminated the necessity for larvicidal work this year.

Purchase orders were placed for 45,000 pounds of dynamite costing a total of $5850. The use of dynamite continued to play an important part in the construction of ditches, with six projects in operation in four States.

Draglines were being used on two projects in North Carolina, and on one in South Carolina.

EDUCATIONAL MATERIAL TO BE DISTRIBUTED
MOTION PICTURE PRODUCTION STEPPED UP

During the month of July the Education and Training Section devoted a large portion of its time to the preparation of a pictorial presentation of the Malaria Control in War Areas program. Designed not only to review the activities of the program during the past year, but also to depict the wide and complex scope of the malaria problem, it should give the MCWA personnel a better overall picture of the program, and be useful for general training purposes. Feeling that this pictorial record can be of great value as a basis for dissemination of correct information on the malaria problem and its control, the Education and Training Section hopes to make it available for wide distribution.

Plans were made to stimulate interest in educational activities wherever practical and possible by the men in the field. Feeling that many of the MCWA personnel have already become aware of the need for a wider educational program, the Education and Training Section made available for distribution a limited number of pamphlets and informational aids. These may be had by writing to the headquarters office, attention Education and Training Section. An appeal is also made for suggestions for material which would prove useful for distribution.

Production of motion pictures moved forward at an accelerated pace. Shooting of the film "Dynamite" was completed and one on water management was begun. Technical films on *Anopheles quadrimaculatus* and *Aedes aegypti* neared completion. Trailers on *Aedes aegypti* for showing in commercial theatres were released.

A member of the headquarters staff presented the facts of malaria to a meeting of the health officers of Michigan at Battle Creek on July 21. Included in the program were two motion pictures on malaria which met with considerable interest.

DOCTORS DECIDE TO DO BLOOD SLIDE SURVEY
HOPE TO CONDUCT TWO SMALL HOUSE-TO-HOUSE CHECK

At a conference on July 3 the Medical Section decided to conduct only a limited blood slide survey this fall. Malaria incidence is too low to make possible a statistically significant comparison of areas in which malaria control operations are being conducted with areas that are otherwise similar. Before a definite decision was made, however, the various States concerned were consulted to determine their wishes in the matter. Conferences were held with 12 States, and letters of inquiry sent to two others. The consensus of opinion seemed to be that a general survey is not feasible at this time.

It is planned to have MCWA personnel assist those States that have carried on surveys for a number of years and whose program requires outside help this year.

Tentative plans were made to conduct two small but intensive house-to-house surveys; one in the Santee-Cooper region in South Carolina, where a large aluminum plant may soon be constructed, and the other at Newport, Arkansas or in northwestern Louisiana.

AEDES AEGYPTI PROJECTS SHOW LOW INDEXES
MIAMI WORKERS INTENSIFY INSPECTIONS

At the end of July the *Aedes aegypti* breeding index of each city under control was below five percent, with the exception of Savannah, Georgia; San Antonio, Texas; and Miami, Florida. In Savannah, scarcity of personnel continued to plague the project making it difficult to combat the rising index. Although 12 inspectors have been authorized, the number employed has averaged only about eight.

In Miami much effort has been concentrated on raising the efficiency of of the inspectorial staff so as to avoid missing breeding places. This tends to reflect at once in a higher breeding index but should result in an eventual lowering of breeding.

Two new ideas have been utilized in Miami. The first is following up inspections with post cards to householders where breeding was found. The second is a re-inspection within 20 days to check on the effect of the cards.

The rise in the Key West index, as reported in June, has been held to between three and four percent. Most of the exterior breeding is now occuring in barrels, tanks, and tubs, while the chief interior offenders are water plants.

All Texas projects, except San Antonio and Hidalgo County, are now making some interior inspections and computing a separate interior breeding index. The interior indexes range from 0.0% in Brownsville to 1.29% in Houston. On an average in Texas outside breeding was found in July to be about twice as heavy as interior breeding.

Final arrangements were made for the continuance of the New Orleans project. The same office and field storage will be furnished by the city health department and a total personnel quota of 20 has been set. To date approximately

65% of the city's blocks have been covered by *Aedes aegypti* inspectors.

Experimentation with phenothiazine and other larvicides has continued in the Savannah laboratory and it is expected that the results will give much beneficial information to the entire *aegypti* program.

TABLE IV
MCWA ENCUMBRANCES BY MAJOR ITEMS
JULY 1943

	Continental U.S.	Puerto Rico
.01 Personal Services	$477,876	$23,750
.02 Travel	9,121	300
.03 Transportation	3,000	---
.04 Communications Service	835	25
.05 Rent	1,677	---
.06 Printing and Binding	---	---
.07 Other Contractual Services	847	---
.08 Supplies and Materials	17,625	2,566
.09 Equipment	6,554	149
Sub-total other than Personal Services	39,659	3,040
Total	517,535	26,790

MCWA ENDORSES PAYROLL SAVINGS PLAN CHART SHOWS STATES' PARTICIPATION

In September 1942 the Malaria Control in War Areas program adopted the Payroll Savings Plan to provide its employees with a uniform automatic means of purchasing War Bonds. As shown on the following chart, 18 of the 19 States included in the program were participating by July 31, 1943. Two States, Alabama and Indiana, had achieved 100% participation, and the MCWA employees in Oklahoma had pledged 10.5% of gross earnings for bonds.

The MCWA program heartily endorses the Payroll Savings Plan, and every effort is being made by the headquarters office to effect swift, efficient handling and issuance of bonds. When the plan was first inaugurated the difficulties encountered in setting it in motion caused considerable delay in bond issuance, but these have been overcome and bonds should now be in the purchasers' hands within two weeks after payment has been completed.

The chart shows that in several States the percentage of employees purchasing bonds through the Payroll Plan is low. In several instances this is caused by the use of other methods of bond buying. The headquarters office is taking every opportunity to call to the attention of the States the advantages of the Payroll Savings Plan and hopes to report 100% participation in all States in the hear future.

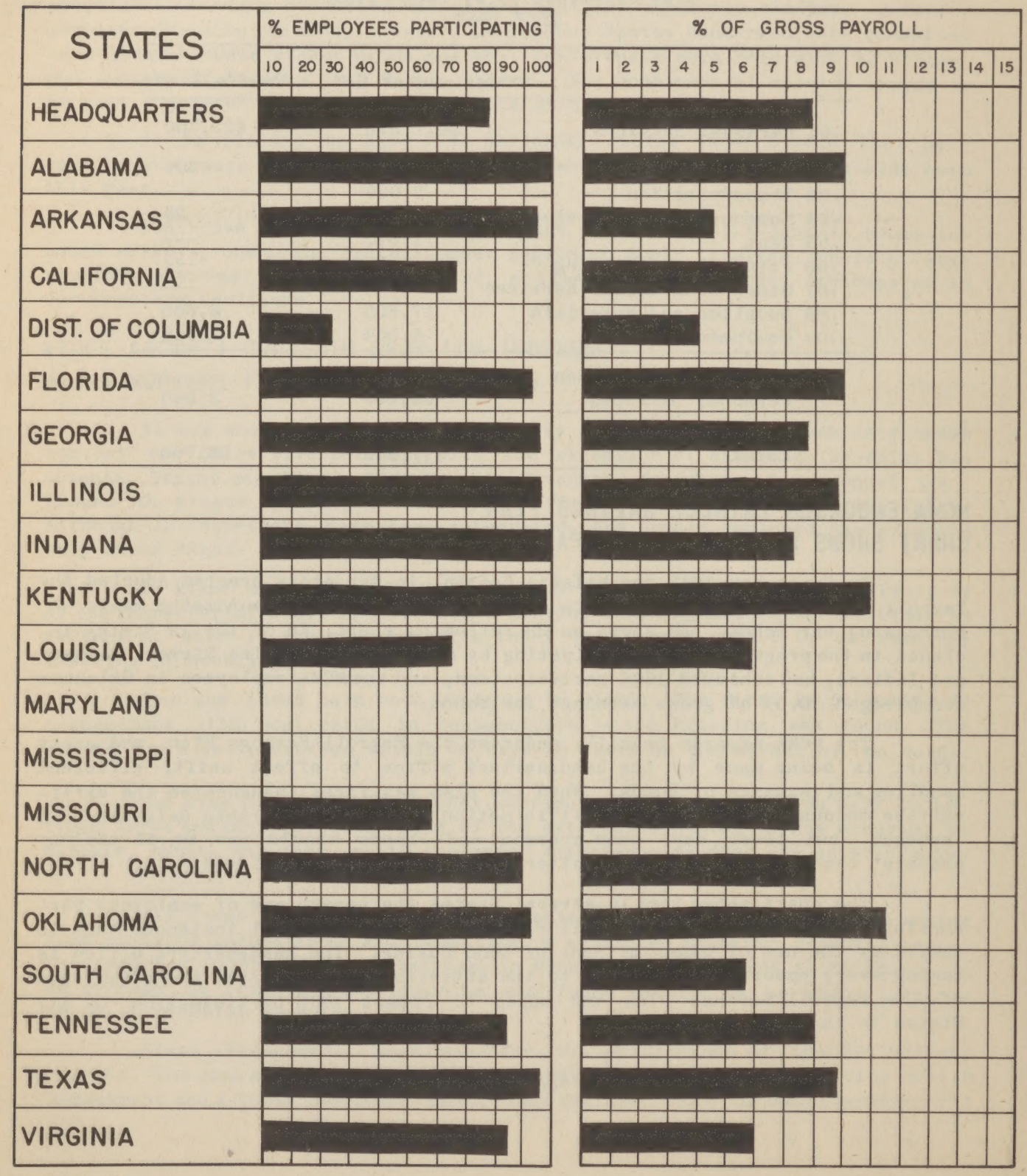
KEEP 'EM BUYING

MALARIA CONTROL IN WAR AREAS

STANDINGS OF STATES AS OF JULY 31, 1943 IN

PURCHASE OF WAR SAVING BONDS

BY PAYROLL SAVINGS PLAN



SIMPLE FIELD AND LABORATORY TESTS OF LARVICIDES

The ultimate criterion of the effectiveness of a larvicide is its ability to kill mosquito larvae. A larvicide, properly applied in sufficient quantity to breeding places, should result in effective control of mosquito breeding. When this does not occur, it indicates that something is wrong with the larvicide. Larvicides being used in control operations should be constantly checked, particularly in the field, to determine their effectiveness.

PARIS GREEN

Paris green which conforms to proper specifications as to chemical structure and particle size (see February 1943 MCWA Monthly Report) is known to be toxic to anopheline larvae when applied in very small amounts. Laboratory experiments have shown clearly that amounts of paris green so small as to escape visibility under the hand lens may poison all larvae in a container (Barber). From other laboratory experiments it may be assumed that the minimum lethal dose for fourth instar *A. quadrimaculatus* larvae is less than 0.0000004 gms of paris green.

An approximation of the relative toxicity of different paris green dusts may be obtained as follows: A larva is placed in a Petri dish containing water and observed under a hand lens. When it is feeding well, a very small amount of paris green is carefully applied to the water surface near the larva. As soon as it has ingested a small particle, it is removed by pipette to a second dish, washed, and put into a third where the time of its survival is noted.

Pan toxicity tests may be made to ascertain effectiveness. Ten or more second, third and fourth instar larvae are introduced into a pan partially filled with water, and the larvicide in the paris green-diluent mixture and at the same rate of application as that to be used in the field is dusted over the surface of the water. An effective paris green should give a complete kill within two hours.

Dosages of larvicide determined by laboratory means are not always effective under field conditions, where the spread of the dust may be obstructed by scum, algae, floatage, and other factors. An effective field dose may be determined by sampling the larval population at specific points in breeding areas before and after application of known dosages of the larvicide. A light treatment should be tried first and the dosage gradually increased until it is found to be effective. Checking of mortality should be performed on the day following the application.

Petri dishes or other containers partially filled with water and with a known number of larvae in each may be placed at various points in the breeding area shortly before applying the larvicide. The dishes can be examined after the dusting and the percentage of mortality determined.

PETROLEUM OIL

Petroleum oils do not, as many people believe, kill mosquito larvae and pupae by suffocation. The volatile components of the oil exert direct toxic effects on the tissues of the larvae and pupae which result in their death. The evidence indicates that volatility is directly correlated with toxicity (Freeborn and Atsatt). Oils of low boiling range and high volatility exert a direct toxic action within a very short time. A high boiling, nonvolatile, viscous oil, on the other hand, may slowly cause death within a longer period.

A larvicidal oil should approximate the following specifications as nearly as possible:

Type of Oil:	Light distillate fuel or Diesel
Gravity (A.P.I.)	27-33
Flash Point	130° or higher
Viscosity S. U. (a) 100° F.	35-40
Spreading Coefficient	16 dynes/cm or higher

Distillation:

10%:	430° - 450° F.
50%:	510° - 550° F.
90%:	630° F or higher

Blends made from fractions of widely divergent volatility and viscosity are likely to be ineffective and uneconomical.

Toxicity:

The toxicity of larvicidal oils can be determined in the field by sampling the larval population of a breeding area before and after spraying, as has been described for paris green. It should be remembered that factors other than the toxicity of the oil may influence the kill.

The easiest and most simply performed field or laboratory test to determine toxicity is to introduce at least ten (preferably 50) larvae and some pupae into a jar, pan, or other container partially filled with water and then apply a thin surface film of the oil being tested. The time elapsing before the larvae and pupae are dead, or the fact that the larvae and/or pupae are not all killed, indicates the relative toxicity of the oil.

In another test, described by Herms and Gray, the larvae and pupae are placed in a tall glass cylinder not over two inches in diameter, filled with clean water almost to the top. A glass tube which has been connected by means of rubber tubing to a source of water supply is inserted to the bottom of the cylinder (figure 1). Several glass containers filled with water and a glass tube with a rubber suction bulb at one end are placed adjacent to the cylinder. A film of the oil to be tested is put onto the water surface in the cylinder, with as little disturbance as possible. After 30 seconds (using a stop-watch, if available), provided all the larvae and pupae have been in contact with the oil, fresh water is introduced gently through the glass tube to float off the oil, which is finally absorbed with blotting paper or similar material. The larvae and pupae are transferred by means of the glass tube with suction bulb to a jar of clean water. They should then be kept under observation to determine the time of death.

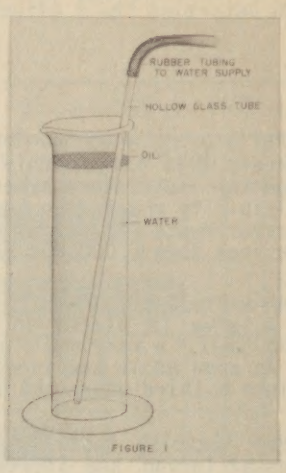


FIGURE 1

Repeat the experiment, increasing the time of contact by half minute increments up to a total of five minutes. If an oil will not kill within a total contact time of five minutes, it is probably insufficiently toxic to be of use for mosquito control. (Contact time should not be confused with the elapsed time after initial contact with the oil film).

The following test as described by W. A. L. David, should result in a mortality of at least 50% when *Aedes aegypti* is the test insect, or at least 90% when *Anopheles quadrimaculatus* is used. The test should be conducted at 77° F.

Take a china or enamel hand bowl about 12 inches in diameter and thoroughly clean it with water (hot water may be used with advantage but avoid the use of soap). Nearly fill the bowl with clean water, bringing the temperature to 77 F. From a bottle having a short neck about 1 inch in diameter remove the bottom at such a level that the mouth of the neck is about 2 inches above the water surface (figure 2).

When the bottle prepared as described is standing in the bowl, put larvicide on the water surrounding the neck. The bowl should be covered with a complete film right up to the edge; if this is not the case, the apparatus was insufficiently washed. For a bowl 12 inches in diameter, use 0.5 ml. larvicide, i.e., enough to form a film about 10 μ (μ = one-one thousandth mm.) thick.

By following the above technique it is possible to get the larvae under the evenly spread film without any possibility of accidentally oiling them.

Allow the larvae to remain under the oil film for 30 minutes, and then remove them to a clean beaker by running the pipette through the neck of bottle. Remove those at bottom first and if necessary any larvae sticking in the surface film may be caused to sink by touching with a glass rod. Set the beaker aside (preferably at about 77° F.) and observe the larvae after 24 hours. If larvae show no sign of swimming movement after gently touching with a glass rod, they may be considered dead.

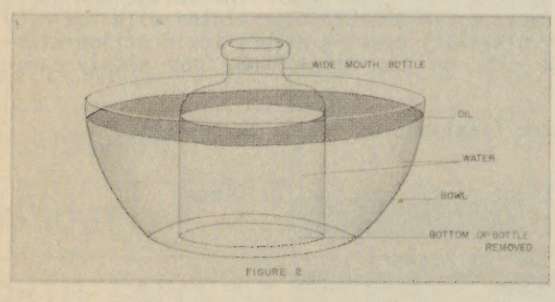


FIGURE 2

(A "control" of equal number of larvae should be prepared and handled in the same manner except exposure to the larvicide. Fifty test larvae will yield more statistically significant data.)

Tests similar to those described above can be used to determine the toxicity of pyrethrum-oil emulsion and other surface acting liquid larvicides.

SPREADING COEFFICIENT

The spreading coefficient of larvicidal oil is of fundamental importance since it is in index of water surface coverage, i.e., whether the oil will spread rapidly and evenly so as to produce a thin, uniform, unbroken film on the entire water surface or whether it will remain in thick localized patches. The spreading coefficient of a larvicidal oil should not be less than 16 dynes per cm.

A simple qualitative determination of this property may be obtained by observing carefully the spreading action of the oil when it is applied to actual breeding places, or when a drop or two of the oil is allowed to fall in a container of some sort.

A more quantative determination may be made by utilizing castor oil, which has a spreading coefficient of about 16 to 20 dynes per cm. A 6-8 inch diameter glass funnel is fixed in an upright position with the stem connected by rubber tubing to a water supply (figure 3). The apparatus should be set up over a sink or some other receptacle to dispose of the waste water.

Water should be introduced through the rubber tubing and allowed to overflow from the funnel for a short time until a completely clean surface is obtained. The water is then turned off and the funnel tilted slightly and straightened again so as to bring the water surface to about one-eighth inch below the rim of the funnel.

A clean glass rod held in one hand is dipped into the sample to be tested while a rod in the other hand is dipped into castor oil. A drop from each rod is lowered on to the water surface simultaneously. The spreading of the oils is observed by looking along the water surface horizontally.

If both oils occupy an approximately equal area of water surface, their spreading coefficients are about equal (16-20 dynes/cm). If the castor oil spreads over the greater portion of the water surface, the larvicidal oil has a spreading coefficient below 16-20 dynes/cm; if the difference in spread is very great, the larvicide cannot be regarded as satisfactory. The larvicidal oil has a spreading coefficient greater than 16-20 dynes/cm. and is satisfactory when it occupies most of the water surface.

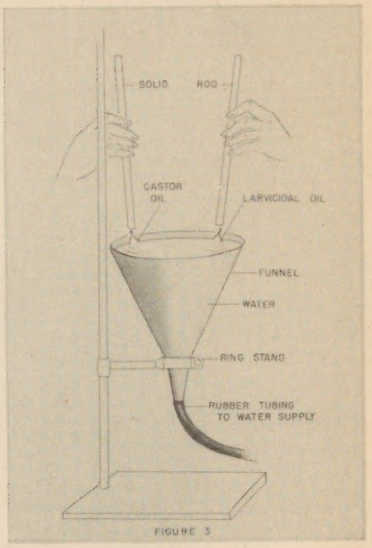


FIGURE 3

SPECIFIC GRAVITY

Since the oil must form a surface film on the water, the specific gravity of the oil should not approach too closely that of the water. A specific gravity of 0.83 to 0.86 (20° C/4°C) is satisfactory although it may be somewhat higher. A hydrometer can be used to read the specific gravity directly. When a hydrometer is not available gently drop a layer of oil about one-eighth inch thick on the surface of the water in a glass vessel. Stir and allow to stand for about 15 minutes. If the water is clean and the oil/water interface is sharp, the oil may be judged satisfactory.

VISCOSITY

The viscosity, or resistance of the oil to flow, is of importance since it is concerned with the passage of the oil through the respiratory openings and along the tracheal tubes of the larvae and pupae. If too viscous, penetration is inhibited or retarded. In addition, it is more difficult to spray the thick heavy oils of higher viscosity. A viscosity range of 35 to 40 (Saybolt Universal at 100°F) is most satisfactory.

Ring the outlet tube of an ordinary 25 to 50 cc. pipette about 2 inches below the bulb with a piece of gummed paper. Prepare a mixture of 60 volumes glycerine (95% pure) and 40 volumes distilled water. (Measure the glycerine and water separately and then combine; do not measure 60 volumes glycerine and then add enough water to make 100 volumes.) This mixture has a viscosity of 45* Saybolt Universal at 100° F. Bring the mixture to 70° F by cautiously warming over a small flame or cooling if necessary. Draw mixture into pipette, fix the pipette vertically in a clamp and take the time in seconds for the solution to flow out from the graduation mark down to the gummed paper ring. Repeat the test and take the average time. If possible, use a pipette with outflow of 30-60 seconds. Clean out pipette, dry, and having brought larvicidal oil to 70°F run it through in the same way. The time taken should not exceed that for the glycerine/water mixture.

*Viscometer reading by William Spicer, Georgia Institute of Technology.

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AIRPLANE DUSTING
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